Amendment to the Specification

In the Specification:

Please amend the specification as follows:

On Page 11, the last paragraph on the page paragraph beginning at line 24 should be replaced with the following.

Because it is anticipated that the present invention will be particularly useful in research environments that do not require large volumes of product to be generated, it is anticipated that a reaction module that incorporates a microreactor will be particularly suitable. Such a microreactor is described in commonly assigned, co-pending U.S. Patent Application, Serial No. 09/496,999, entitled "MINIATURIZED REACTION APPARATUS," which was filed February 3, 2000, the disclosure ~~in the specification and drawings~~ (including the specification and drawings) of which is hereby specifically incorporated herein by reference. Furthermore, a suitable reaction module is described in commonly assigned, co-pending U.S. Patent Application, Serial No. 09/578,224, entitled "~~AMENDMENT AND REQUEST FOR RECONSIDERATION~~ MODULAR CHEMICAL PRODUCTION SYSTEM INCORPORATING A MICROREACTOR," which was filed on May 24, 2000, the disclosure ~~including in the specification and drawings~~ (including the specification and drawings) of which is hereby specifically incorporated herein by reference.

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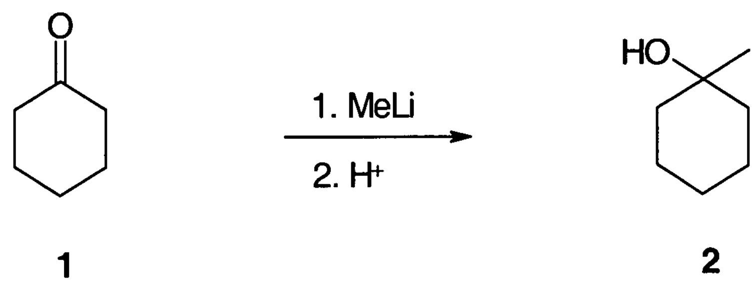
LAW OFFICES OF RONALD M. ANDERSON
600 - 108th Avenue N.E., Suite 507
Bellevue, Washington 98004
Telephone: (425) 688-8816 Fax: (425) 646-6314

On Page 29, immediately before the final paragraph of the Description of the Preferred Embodiment, please add the following paragraphs (which are not new matter, as the added paragraphs are from U.S. Patent Application, Serial No. 09/496,999, which was specifically incorporated by reference in the present application when the application was originally filed).

Exemplary Chemical Reaction Performed in a Stacked Simple Plate Reactor



The described chemical reaction belongs to the class of organometallic conversions, i.e., the addition of an organolithium compound to a carbonyl compound. Cyclohexanone (**1**) reacts in a one step procedure with methyl lithium to produce the 1,2-addition product 1-methyl-cyclohexanol (**2**).

Supply of the Starting Materials:

1. A 1.5 molar solution of methyl lithium dissolved in diethylether (commercially available in 100-ml bottles sealed with a septum).

2. Preparation of 100 ml of a solution of 13.2 grams (0.15 moles) of cyclohexanone (commercially available liquid) in dry diethylether.

Solution No. 2 is transferred into a pressure compensated bottle with tube connectors. Both solutions are connected to an argon atmosphere prior to use to avoid hydrolysation with air.

Thermal Conditioning and Setting up of the System:

The reactor temperature is adjusted to –20°C by cryostats, which are connected to the heat exchangers of the reactor. Solvent (diethylether) is pumped continuously through the complete system until the solvent flow leaving the reactor has reached –20°C.

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Performing the Reaction:

After reaching thermal equilibrium, the two-reactant solutions are transferred by individual pumps via Teflon™ tubing into the reactor. The pump rate is set to 1 ml/min for each reactant. The two reactant flows are each divided into four parallel laminar flow streams with dimensions of several micrometers. They enter the inter-digital-mixer located under heat exchanger 1, which is a cross flow type heat exchanger, where they are cooled to the appropriate temperature (-20°C). It should be noted that this temperature is a function of the desired reaction. In some cases, each reactant may require pre-treatment to obtain a different reactant temperature. Thus, the stacked simple plate reactor may preferably include a heat exchanger for modifying the temperature of each reactant. Of course, if the reactant temperatures are to be the same, then a stacked simple plate reactor can be designed with a single heat exchanger to pretreat both reactants.

In the inter-digital-mixer, the two reactant flows are each divided again into 12 individual laminar flow streams for each reactant. These 24 streams enter the four lamination channels in groups of six streams, where each group of six streams are combined again (stacked onto each other). From here, the four groups of six stacked fluid streams enter the four mixing chambers (which are placed under heat exchanger 2), and the four groups of six stacked fluid streams are reduced in thickness so that diffusion mixing will occur. Thus, in each of the four groups of six stacked fluid streams, three single streams of reactant A are united with three single streams of reactant B. After mixing, the reactants exit the four mixing chambers at two exits per mixing chamber, thus resulting in eight mixed reactant streams. These eight mixed reactant streams enter the eight reaction channels, which are sandwiched between heat exchangers 3 and 4. It is within the reaction channels that the final reaction takes place, and it is here that the most heat is generally produced; thus the reaction channels are sandwiched between two heat exchangers.

Heat transfer is extremely efficient due to the high surface to volume ratio, to the selection of an extremely thermally transparent material for the simple plates that form the heat exchanger (by the control of the material and/or the thickness of the

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600 - 108th Avenue N.E., Suite 507
Bellevue, Washington 98004
Telephone: (425) 688-8816 Fax: (425) 646-6314

simple plates), and to the thinness of the simple plates (the distance between the mixing zone and heat exchanger is in the range of a few micrometers). Thus, the heat of the exothermic reaction can be reduced to 1-2°K above the determined reaction temperature.

The internal volume of the mixing zone is approximately 1 ml, providing a residence time of 30 seconds, during which the majority of the reaction is completed. For reactions that need a longer reaction time, an additional residence time chamber can be added to the reactor, either by using additional simple plates, or by adding a separate residence chamber module downstream of the reactor.

The resultant product stream leaves the reactor via a Teflon™ tube into a collection flask that is filled with 2N hydrochloric acid. Instant quenching of the addition adduct and excess reagent takes place.

<u>Benefits of the Simple Plate Stacked Reactor:</u>

Advantages of the stacked simple plate reactor system are precise temperature control, exact adjustment of reaction time, and eliminating the need of a protective atmosphere, since the reactor is a closed environment. Enhanced safety is provided due to the small quantities of material, and the closed environment operating conditions.

The system is especially advantageous when large quantities of product are required, because the reactor can work continuously, and can be operated for hours, even up to days, without maintenance. Accordingly, automated production of large amounts of the desired product without the loss of efficiency and safety can be achieved. Additional product can be obtained by operating additional reactors in parallel under identical operating conditions.

<u>System Description:</u>

The reactants are provided in conventional laboratory bottles with tube connectors. The bottles are connected to a pump module by Teflon™ tubes. Inside a pump module disposed upstream from the pumps are three way valves, which are connected to the reactants, the solvents, and the pump inlet. For conditioning the stacked simple plate reactor, the valves are set to the solvents, so that the pumps first

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600 - 108th Avenue N.E., Suite 507
Bellevue, Washington 98004
Telephone: (425) 688-8816 Fax: (425) 646-6314

fill the whole system with solvent until the stacked simple plate reactor reaches thermal equilibrium. Then the valves are set to the reactants, enabling the pumps to deliver the reactants into the stacked simple plate reactor. A filter is placed inline between the pump outlet and reactor inlet to avoid clogging of the system by particulates. Fluidic connection of pumps and reactor can be achieved by commercially available HPLC fittings. Controlling the temperature of the stacked simple plate reactor is achieved by pumping heat transfer media from a cryostat into the internal heat exchangers of the stacked simple plate reactor. Product coming out of the system is collected in a conventional laboratory bottle.

Measuring and Automation Control Devices:

All pumps, valves, and cryostats are preferably controlled by a microcontroller or computer, programmed with appropriate software, enabling convenient adjustment and control of the system. The following sensor devices are optionally used to provide analog signals that are converted to digital signals for input to the microcontroller or computer, to facilitate more efficient manual or automated control of the chemical process:

- Pressure sensors disposed downstream from each pump and at the inlet and outlets of the stacked simple plate reactor.
- Temperature sensors integrated in the stacked simple plate reactor and disposed close to the mixing zone and at the reactor outlet.
- Optional flow sensors introduced into each reactant stream for improved flow adjustment.
- Excellent control and adjustment of flow and ratio of the reactants, determination of the pressure buildup inside the system by differential pressure measurement, and exact adjustment and control of the reaction temperature can thus be achieved.

LAW OFFICES OF RONALD M. ANDERSON
600 - 108th Avenue N.E., Suite 507
Bellevue, Washington 98004
Telephone: (425) 688-8816 Fax: (425) 646-6314